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The effect of humidity on fungal succession on deer dung

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鹿糞上の菌類の遷移に対する湿度の影響

Dickinson & Underhay (1977) reported that colonization and sporulation of coprophilous fungi were influenced by the moisture content of dungs at a laboratory or in the field. Harrower & Nagy (1979) studied the relation between the growth of coprophilous fungi and water stress of 12 media and emphasized the importance of moisture content on coprophilous fungal succession. Moreover, they revealed the contradiction of nutritional hypothesis.

In the present study, we carried out experiments on the effect of relative humidity upon fungal succession on deer dung.

Materials and Methods Dung pellets which were collected at Miyajima Island, Hiroshima Pref., on April 24, 1979, were air-dried for about two weeks at room temperature and stored. Then, dung pellets were incubated at three different levels of relative humidity. In order to maintain each level of relative humidity (RH) in a moist chamber, the following salt solutions were used; 1) RH 90-93%: saturated solution of $NH_4H_2PO_4$. 2) RH 70-72%: saturated solution of the mixture of NH_4H_2Cl and HNO_3. 3) RH 25-35%: saturated solution of $CaCl_2 \cdot 6H_2O$. One of these solutions was poured into a moist chamber in which ten Petri dishes were laid. The bottom of each dish was covered with a filter paper on which five pellets were put. In the case of 25-35% RH, however, the number of observed pellets were 25. In all cases, pellets were soaked in sterilized water for 10 seconds in advance and they were incubated at 25°C with condition of 12 hr darkness 12 hr light (200 lux, luminescent light). Fungi which grew on the dungs were observed with a stereo-microscope during the period of about two weeks after incubation and were recorded by means of percentages of the occurrence. Namely,

$$\text{occurrence percentage } (\%) = \frac{\text{number of dung pellets bearing fruit bodies}}{\text{number of total dung pellets}} \times 100$$

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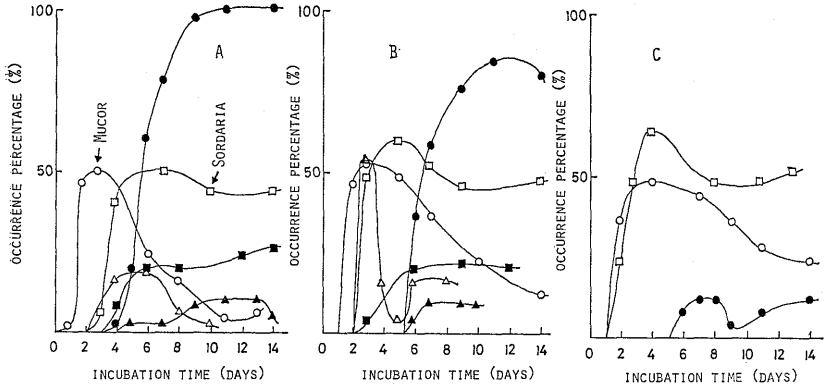

Fig. 1. Occurrence percentage of each fungus recorded from deer dung at the three different levels of relative humidity: A, 90-93%; B, 70-72%; C, 25-35%. ○-*Mucor mucedo*, △-*Pilobolus crystallinus*, □-*Sordaria humana*, ●-*Sporormiella minima*, ▲-*Saccobolus sp.*, ■-*Lasiobolus cuniculi*.

Results The following six species were mainly observed on deer dungs within two weeks after incubation. They are *Mucor mucedo* (L.) Fresenius, *Pilobolus crystallinus* (Wiggers) Tode, *Sordaria humana* (Fuckel) Winter, *Lasiobolus cuniculi* Vel., *Sporormiella minima* (Auersw.) Ahmed et Cain and *Saccobolus* sp.

Growth patterns of *Mucor mucedo* and *Sordaria humana* were similar at three different levels of RH (Fig. 1). *Sporormiella minima* showed poor growth at low RH. *Pilobolus crystallinus*, *Lasiobolus cuniculi* and *Saccobolus* sp. did not appear on dungs at 25-35% RH. Also, *L. cuniculi* and *Saccobolus* sp. attained similar growth curves under both conditions of 90-93% and 70-72% RH. Growth of *Pilobolus crystallinus* under 70-72% RH was better than that under 90-93% RH. In the non-soaked treatment of dungs, no fungus grew at 25-35% and 70-72% RH, but under 90-93% RH, only *Aspergilli* and *Penicilli* grew after one week.

Under both the conditions of 90-93% RH and 70-72% RH, sequence of fungal succession is almost similar. *Mucor mucedo* appeared first and then followed by *Pilobolus crystallinus*, *Sordaria humana* and *Lasiobolus cuniculi*. *Sporormiella minima* appeared 3-5 days after incubation and *Saccobolus* sp. occurred last (Fig. 2).

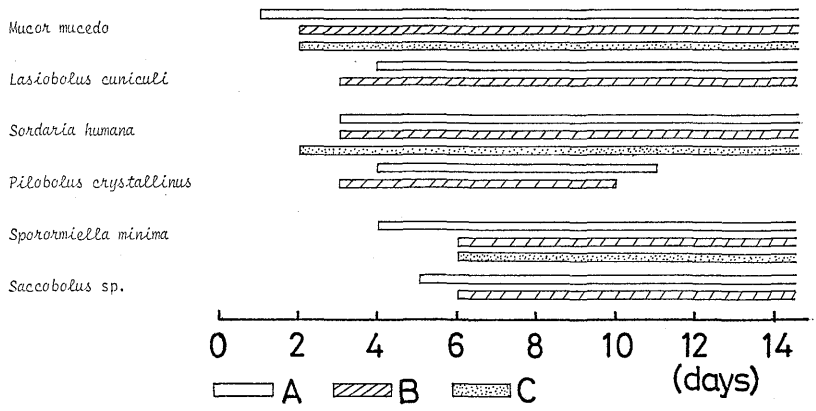

Fig. 2. Occurrence period of fruiting bodies on deer dung at the three different levels of relative humidity. A; 90-93%, B; 70-72%, C; 25-35%.

In each level of relative humidity, moisture contents of dung pellets which had been soaked in sterilized water before used were measured. There were 19-20%, 13-14% and 8-9% under the conditions of 90-93% RH, 70-72% RH and 25-35% RH, respectively. Under the condition of 90-93% RH without soaking, moisture content was 7-18%.

Discussion Many moulds, including species of *Aspergillus* and *Penicillium*, are able to grow in the presence of very little moisture. It is known that the minimum moisture required in certain fungi occurring on maize grain are 18.3% in *Aspergillus niger* and *A. flavus*, 18.4-21.2% in *Fusarium moniliforme* and 15.6-20.8% in *Penicillium* spp. (Hawker, 1950).

In this experiment, under the condition of 90-93% RH without soaking in sterilized water, moisture content of deer dungs was 7-18%. Therefore, the result that only *Aspergillus* and *Penicillium* grew on dungs under the condition of 90-93% is coincident with the description of Hawker (1950). Although in an ordinary circumstance fungi can not grow under the condition of 25-35% RH, they can grow if the dung pellets would be soaked in water in advance before used. Dung pellets continued to change from the condition of supersaturation to each level of the three relative humidity within 24 hr. *Mucor mucedo* and *Sordaria humana* showed the similar pattern of growth invariably at the different levels of relative humidities.

Literature cited

Dickinson, C. H. & V. H. S. Underhay. 1977. Growth of fungi in cattle dung. Trans. Br. Mycol. Soc. **69**: 473-477.　Harrower, K. M. & L. A. Nagy. 1979. Effects of nutrients and water stress on growth and sporulation of coprophilous fungi. Trans. Br. Mycol. Soc. **72**: 459-462.　Hawker, L. E. 1950. Physiology of fungi. 360 p. J. Cramer, Lehre.

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鹿糞における菌類の遷移におよぼす相対湿度の影響について調べた。その結果，湿度35%，72%，93%のいずれの条件でも *Mucor mucedo*, *Sordaria humana* は同じような生育のパターンを示した。*Sporormiella minima* は湿度が低くなるにつれて生育が悪くなった。また，*Pilobolus crystallinus*, *Lasiobolus cuniculi*, *Saccobolus* sp. は湿度35%の時は全く生育してこなかった。菌類の遷移を調べるためには湿度を過飽和の状態にする必要がある。

□Kartesz, J. T. & Kartesz, R.: **A synonymized checklist of the vascular flora of the United States, Canada and Greenland** xlviiii+498 pp. 1980. The Univesity of North Carolina Press, Chapel Hill. 昨年6月，アメリカ合衆国，カナダ，グリーンランド，西インド諸島（プエルトリコ，バージン諸島を含む）をカバーした表記のチェックリストが出版された。このリスト作りは，Biota of North American Program の一環として，1973年に着手，主として1900年以降に出版された関係地域の文献を網羅し，コンピューター手法によって整理したのち，250名余の植物分類学の専門家によってチェックされて完成した。

植物の配列は，シダ植物・裸子植物・被子植物の順に，各群内では科・属・種・変種ごとにアルファベット順に並べられ，それぞれ選択された異名が付されている。帰化植物と雑種は含むが，品種や栽培変種は含まれていない。基本資料として収集された学名は30万余に及んだが，本の適正サイズやコストを勘案の上，異名については Manual レベルに止めたという。結局，変種から属まで56431の名がリストアップされている。内訳は次の通りである。

	科	属	種	亜種	変種	雑種	異名
シダ植物	24	108	789	16	175	48	690
裸子植物	6	20	125	0	45	10	98
被子植物	224	2793	20674	2475	7788	682	19641
計	254	2921	21588	2491	8008	740	20429

したがって，現在使用されている北アメリカの標準的な学名を知り，フロラの規模を知るには大へん便利である。欲をいえば，さらに分布域や自生か野化かなどの短かい記事があったらと思う。わずか数年のうちに編集が完了し，250名もの分類学者が動員できるとは羨しい。私が Chapel Hill で求めた価格は29ドルであった。（清水　建美）